



PROCEEDINGS
OF THE
LINNEAN SOCIETY
OF
NEW SOUTH WALES.

WEDNESDAY, MARCH 26TH, 1913.

The Thirty-eighth Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 26th, 1913.

ANNUAL GENERAL MEETING.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 27th, 1912) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.

During the past year, twenty-five individuals passed the ballot, but only twenty of them accepted the obligations of membership. A new edition of the Rules, with an up-to-date List of Members, has been distributed with Part 3 of the Proceedings for 1912, from which it will be seen that the number of Ordinary Members now on the Roll is 167—a larger number than the Society began with in 1875 (105), but a smaller number than it has had at some periods of its history.

Though this meeting is only the Thirty-eighth Annual General Meeting, I may remind you that the Society had a predecessor, the Entomological Society of New South Wales, which, had it survived, would have been in a position to celebrate its jubilee last year. The first Monthly Meeting of the Entomological Society was held on 5th May, 1862. The meetings were continued until July,

1873, at somewhat irregular intervals towards the last; and then the Society came to an end. Meanwhile the Society published ten annual Parts of its Transactions, forming two complete volumes, Part i., having been issued in 1863, fifty years ago this year. These publications are of special interest, because they were the first scientific serial publications issued by a scientific society in New South Wales. The half-century anniversaries to which I have alluded, though interesting in themselves, because suggestive of the great development in education generally, and especially in science, of which we to-day are cognisant, are also of particular, though melancholy, interest to us, by reason of the recent deaths of two of the veterans, Mr. George Masters, and Dr. James C. Cox, within a few months of each other.

George Masters was born in Kent, England, in July, 1837. He emigrated to Tasmania, while still a young man, and subsequently entered the service of the late Dr. Howitt, of Melbourne, who formed the Howitt Collection of Insects, now in the National Museum, Melbourne. His association with Dr. Howitt may be supposed to have stimulated Masters' interest in natural history, and especially in entomology. Be that as it may, the pamphlet on the "Fauna of Tasmania," published by Mr. G. Krefft, in 1868, is said by the author, to be based on the observations of Mr. George Masters. We first hear of Masters, in connection with scientific matters, as a visitor, introduced by Sir William (then Mr.) Macleay, at the third meeting of the recently established Entomological Society of New South Wales, on 7th July, 1862. He had just returned from an important collecting visit to Port Denison, then newly settled, undertaken in the interests of Sir William Macleay's Collection. Hence it is a reasonable supposition, that Mr. Masters came to Sydney in the year 1860, or perhaps early in 1861. The Port Denison collection provided the material for Sir William's earliest contributions to the Entomological Society of New South Wales.

Subsequently Mr. Masters joined the Society. For about two years after his return from Port Denison, he assiduously collected insects in the neighbourhood of Sydney, and in the western portion

of the County of Cumberland, at Eastern Creek and Windsor, as well as in other localities not specified. The exhibition of Mr. Masters' choice collections, from time to time, was one of the most interesting features of the meetings of the Society.

In 1864, Mr. Masters joined the staff of the Australian Museum, Sydney. The official notice of his appointment states that: "An Assistant Curator, of considerable practical experience, has been appointed, who takes an active part in the arrangement of the collection, and occasionally travels in search of natural history specimens; a very large and highly valuable collection, comprising many new genera, has been brought together." During his connection with the Australian Museum, which lasted for ten years, very large and important general collections were made for the Museum. From June to December, 1864, the first year of his appointment, the additions of vertebrates consisted chiefly of birds, together with 5,000 specimens of insects, but localities are not mentioned. Thereafter, he made extensive collections in South and West Australia, at Pine Mountain and in other localities in Queensland, again in West Australia, at Lord Howe Island, at Manero, at the Snowy Mountains, and in the Wide Bay District, Queensland, whence he brought back nineteen specimens of *Ceratodus*. The Coleoptera obtained on this trip, amounted to nearly 16,000 specimens, representing over 1,100 species, according to Sir William Macleay. In 1867, Mr. Masters collected in Tasmania. On his return, after his collection had been exhibited to the Trustees at a Board Meeting, he was specially thanked by letter for his zeal, diligence and skill in making such a splendid collection, and made the recipient of a gift in token of the appreciation of the Trustees. A lengthy account of the history and contents of "The Sydney Museum" will be found in the "Evening News" of May 22nd, 1868, in which appreciative reference is made to Mr. Masters' share in the development and arrangement of the collections.

During the period 1871-74, Mr. Masters published a "Catalogue of the Described Coleoptera of Australia," in five parts, founded upon Gemminger and Harold's "Catalogus Coleopterorum," re-

vised, as far as possible, both as to species incorrectly included, and as to localities. Also, in 1873, a "Catalogue of the Described Diurnal Lepidoptera," and a "List of Australian Longicorns." These useful compilations, though now out of date, did much to help and stimulate Australian entomologists, at that time, when access to, and a knowledge of, the necessary literature, was so difficult to acquire. They are referred to, in an appreciative manner, by Professor Westwood in his Presidential Address to the Entomological Society of London, in 1873.

Mr. Masters retired from the Australian Museum to take up the position of Curator of the Macleay Collection, offered to him by Sir William Macleay, in February, 1874. About a year earlier, Sir William had intimated, to the Senate, his intention of presenting the Macleay Collection to the University of Sydney at some future time. That is to say, Sir William had only an alternative choice in the ultimate disposal of the portion of the Macleay Collection which he had inherited—the original collection of his uncle, Mr. Alexander Macleay, enlarged, and still further developed, by his cousin, Mr. W. Sharp Macleay; and the only other course open to him, was to arrange for its return to a University in England. But Sir William was too keenly interested in Australia, and in an endeavour to put entomology, in common with other branches of Natural Science, on a firm basis in New South Wales, to take any other course than he did.

With the appointment of Mr. Masters, the Macleay Collection began to develop rapidly—by purchase, by the efforts of special collectors, as the result of collecting trips by Sir William and Mr. Masters, sometimes accompanied by Professor Stephens, and especially by the acquisition of the extensive marine and other collections obtained during the expedition to the north-east coast and to New Guinea, in the "Chevert" in 1875. Some record of the consequent expansion of the collection, will be found in the earlier volumes of the Society's Proceedings, and need not now be referred to in detail.

In 1888, a suitable building having been provided for its reception, since then known as the Macleay Museum, Sir William trans-

ferred the entire collection to the University of Sydney, together with the sum of £6,000, for the maintenance of a Curator, with the proviso that Mr. Master should retain the position, which he had so creditably filled for fourteen years, and which he subsequently held up to the time of his decease, on 23rd June, 1912, within one month of the attainment of his seventy-fifth birthday.

I have dwelt at some length upon this notice of Mr. Masters' career, because some such recognition of his more than fifty years' service in the cause of zoological science is due to his memory, and also because of his active interest in the work of the Entomological Society of New South Wales, of his early and long connection with the Linnean Society of New South Wales, of which he was an Original Member, elected in 1874; and also because of his lengthy association with Sir William Macleay, and with the Macleay Collection, in the maintenance, and development of which, he played so important a part; and, lastly, because he was so well known to Australian entomologists, and especially to those of this State, who cannot but gratefully remember their indebtedness to his kindness of heart, to his courtesy and readiness to forward their studies, and to help them, in so far as it was in his power to do so. With the exception of Central Australia and the Northwest, Mr. Masters had collected in some portion of every State in the Commonwealth. He was possessed of an unrivalled knowledge of the habits, and life-histories of Australian animals; and it is much to be regretted that his distaste for the literary side of the subject, has deprived us of much interesting matter, that it would have been advantageous to us to have had on record, because so much of it was acquired under most favourable conditions, when settlement was only just beginning to interfere with the native fauna.

James Charles Cox, M.D., Edin., F.R.C.S., was such a well-known figure in Sydney, that I need not dwell upon biographical details, beyond mentioning that he was the fifth son of Mr. Edward Cox, of Mulgoa, and grandson of Captain William Cox, of the New South Wales Corps, who came to Australia in 1800, and was the progenitor of the numerous-represented Australian branch

of the Cox family. As the Chief Magistrate of the district—for at this time Captain Cox resided at Clarendon, on the Hawkesbury, between Windsor and Richmond—Governor Macquarie, in 1813, entrusted to him the responsible task of getting a road made across the Blue Mountains to the site now occupied by the town of Bathurst, shortly after Blaxland, Lawson, and Wentworth, and Evans had completed their labours; and which Captain Cox carried out very successfully in the face of many difficulties. After completing his medical studies at Edinburgh, Dr. J. C. Cox returned to Sydney, and thereafter engaged in the practice of his profession. Among the official positions which he filled for some years, were Lecturer in Medicine at the University of Sydney, and Chief Medical Officer to the Australian Mutual Provident Society. He was elected to the Board of Trustees of the Australian Museum in 1865, and for a number of years, and up to the time of his death, he was Chairman of the Board. For a lengthy period, under the old régime, he was President of the Board of Fisheries, and took a great interest in the development of the fishing industry. He was a member of the Philosophical Society of New South Wales, founded in 1856, and contributed a paper "On the Wambeyan Caves," which was read on 9th July, 1862, and which was published in the Transactions of the Society, issued in 1866.

We have a special interest in Dr. Cox, because of his active and loyal support of Sir William Macleay in initiating and carrying on the work of both the Entomological Society of New South Wales, and the Linnean Society of New South Wales. He was an Original Member of both Societies. From its foundation in 1862 to 1865, he was Hon. Secretary of the former, and subsequently Hon. Treasurer. His connection with the Society appears to have stimulated his interest in entomology, and led him to make a collection; for the record of one of his exhibits, is of a very small species of *Trox*, which he had found in a *Phalidura* in his cabinet. From time to time, at the Meetings, he exhibited collections from various localities, some of them the results of his own collecting. But even at this time he must have been more interested in conchology. During the period from 1864-1873, he contributed seventeen concholo-

gical papers, descriptive, for the most part, of Australian or Pacific Islands Land-shells, the first to the *Annals and Magazine of Natural History*, for July, 1864, twelve to the *Proceedings of the Zoological Society of London*, two to the *Journal de Conchyliologie*, and one, upon Australian Oysters, to the *Acclimatisation Society of New South Wales*. In 1864, he issued, at his own expense, a "Catalogue of Australian Land-Shells"; and, in 1868, "A Monograph of Australian Land-Shells, with Drawings by Miss Scott, and Mrs. Edward Forde."

When the establishment of a Society of Natural History, which eventually assumed the name of the Linnean Society of New South Wales, was mooted in October, 1874, Dr. Cox was among the first to respond to the call of the promoters, and to offer himself for enrolment as an Original Member. He was elected a Member of the first Council, and retained his seat for a number of years, afterwards; and was the fourth President, in 1881 and 1882. He was the author of a number of papers, while a reference to the published "List of Contributors" to the first ten volumes of the *Proceedings*, and to the continuation in manuscript kept by the Secretary, and still awaiting publication, shows that he took some trouble to add to the interest of the Society's Meetings by bringing noteworthy specimens under notice, and offering observations on matters worthy of record. When the meetings were held in the city, and Dr. Cox resided in Macquarie Street, he was a very regular attendant, notwithstanding his professional engagements. But with advancing age, and his removal to a distant suburb, he became unable to keep up the active interest in the Society, which was, for so long a period, characteristic of him. Apart altogether from his work as medical man, the memory of Dr. Cox deserves to be held in kindly remembrance by all of us, in this State, interested in biology, for his untiring efforts to advance Natural Science, and for his honourable and long record of service extending over a full half century. Dr. Cox passed away on 29th September, 1912, aged 79.

We have also to mourn the loss, by death of the Rev. Thomas Blackburn, B.A., of Adelaide, the senior worker on the Coleoptera,

in Australia; and a Corresponding Member of the Society since 1888. Mr. Blackburn left England in the seventies, to take up clerical work in the Hawaiian Islands. Being interested in entomology, he made a very praiseworthy effort to accumulate a representative collection of the insects of those islands. An account of some of the groups of the Coleoptera, by Dr. D. Sharp, will be found in the Transactions of the Entomological Society of London for 1878, and later volumes; and of the Hemiptera, by Mr. A. White, in the Annals and Magazine of Natural History for 1878. A few years later, Mr. Blackburn, came to Australia, and accepted charge of a parish of Woodville, near Adelaide, where he spent the rest of his life. Soon after his arrival, he took up the study of Australian coleoptera, and became the author of a considerable series of papers on the subject, comprising about thirty papers contributed to the Transactions of the Royal Society of South Australia, the first of which was read in December, 1886, and was published in Vol. x., 1886-87 (1887). The first of his papers contributed to the Linnean Society of New South Wales, was one entitled "Notes on the Hemiptera of the Hawaiian Islands" (Proc. 1888, p. 343); and this was followed by a series of twenty-nine papers descriptive of Australian coleoptera spread over the Proceedings from 1888 to 1904. Mr. A. M. Lea, of Adelaide, has prepared a more detailed biographical sketch than I am in a position to do, together with a bibliography, and an index of the species described by Mr. Blackburn, which will be most useful. This will appear in the Transactions of the Royal Society of South Australia for 1912.

Thirty-seven papers, covering the customary wide range of subjects, were contributed at the Monthly Meetings. Parts i.-iii. of the Proceedings for 1912, containing twenty of these, have been published and distributed, while the concluding Part is now in hand. Under existing conditions, which, are largely subject to the prevailing unrest in industrial matters during a transitional period, our printing does not proceed quite so rapidly as we have been accustomed to; but, so far, we have not been able to overcome the difficulty.

In last year's address, I referred to the Council's responsibility in the matter of the re-investment of the large sum of money comprised in the Society's major security, which matured in August, 1912. Anticipating the Hon. Treasurer's financial statement, I may state briefly, that, when the time came, the Council was able to arrange for a renewal of the great part of the loan on mortgage, for another year, at a somewhat higher rate; while satisfactory investments for the balance were entered into for periods of three or five years, at more satisfactory rates than we have had for some years past.

In the early part of the year, Mr. Henry Deane, resigned from the Council, in consequence of frequent absences through professional engagements, resulting finally in his removal to Melbourne; and at the end of the year, Professor J. T. Wilson also resigned, in consequence of his contemplated absence in Europe during this year. Both Mr. Deane and Professor Wilson have rendered signal service to the Society, as Members of the Council, as well as occupants of the Presidential Chair—Mr. Deane in 1895 and 1896, Professor Wilson in 1897 and 1898, in important periods in the Society's history; so that the Council parts, with both of them, with great regret. We may hope to welcome Professor Wilson back early next year. But Mr. Deane's removal to Melbourne in connection with the construction of the Transcontinental Railway, deprives us of an enthusiastic member keenly interested in botany and allied matters, whose presence and contributions added much to the interest of the Meetings for a number of years, until his official duties, entailing frequent absences from Sydney, interrupted these, as well as his investigations upon fossil plants, which began so auspiciously. Dr. J. B. Cleland was elected by the Council, under the provisions of Rule xiii., to fill Mr. Deane's place for the remainder of the session; while a successor to Professor Wilson will be elected at this Meeting, under the new Rules.

A very important matter carried out during the year, has been the revision of the section of the Society's Rules relating to elections to the Council, and some cognate matters. The existing Rules came into force fifteen years ago, at a time when the Society

had taken over the responsibility of only one portion of the endowments, devised by Sir William Macleay. Since then, additional responsibilities have devolved upon the Council, in taking over and carrying out in its entirety, Sir William's scheme of endowments, the last item of which, namely, the endowment of four Fellowships, is now almost on the eve of realisation. When, therefore, in the early part of the year, the Council was approached by a private member, with some suggestions, it decided to consider the advisability of a revision of the Rules upon all points, which experience had shown to be capable of improvement. The whole matter was referred to the Society's solicitors for advice, and a Sub-committee was appointed to take action. Finally, after consideration by the Council, a draft of the proposed alterations of certain of the Rules, was put before the Members at a Special General Meeting, convened for the purpose, on 27th November, and carried; and subsequently confirmed at a Special General Meeting on 18th December, 1912. The most important alterations provide, if necessary, for a postal vote, instead of an ordinary ballot at the Annual Meeting; and for a three-fourths majority in the matter of any alteration in the Rules. As about 40 per cent. of the Members reside outside the metropolitan and suburban areas, in other countries or States, and are rarely able, or quite unable, to attend any of the Meetings, in addition to those who live nearer but are prevented, by professional or other engagements, from being present, a more extended franchise than we have hitherto had seemed to desirable, because the large amount of money, whose investment is controlled by the Council, is derived from the trust funds bequeathed by Sir William Macleay. The existing Rules are a legitimate development of the Society's original Rules, enlarged in scope, from time to time, to meet new conditions, arising out of the old ones, as experience required. Just as later Councils have endeavoured to carry out and develop, as new conditions required, the policy of the original Council, when Sir William Macleay was, as he has been described, "the head and heart," as well as the financier, of the Society. And so, as the Council of to-day, has had now more than twenty-one years' ex-

perience in the management of the Society's affairs, since the death of Sir William Macleay, in December, 1891, and the existing condition of things has come about in consequence; it was deemed desirable that the alteration of Rule lxiv., so as to provide for a three-fourths majority in the matter of the alteration of the Rules, should receive attention, so that the maintenance of a policy which is founded on precedent as well as experience, should be reasonably safeguarded.

In the bacteriological laboratory, the Macleay Bacteriologist has continued his research into the action of microbiological life in relation to soil-fertility. In the treatment of domestic sewage, it is pumped over poor soils or sandy wastes, and, in passing through, undergoes an amount of putrefaction, which enables the effluent to be discharged into rivers and harbours. After working actively for some time, the soils become clogged, and are so useless that they have to be rested. In the clogged condition, they are said to be sewage-sick, and it has hitherto been supposed that, in the absence of clay, the inactivity was due to the pores and spaces having become plugged with slime. Recently, however, Russell and Golding have claimed that the sickness is brought about by protozoa devouring the decay-bacteria, and preventing their exercising their beneficial function, in consequence of which the soil becomes useless. They were led to this opinion by the fact that, after treatment with heat and volatile disinfectants, the surviving bacteria increase in numbers above those in control tests. The experimental work in the Society's laboratory did not support this contention, for when the protozoa were destroyed by a moderate heat, the volatile disinfection was able to bring about a considerable increase in the numbers of the bacteria. That the disinfectant has an action upon the fatty matters in such soils, was shown by the bacterial growths in the various layers of soil behaving as if the disinfectant had carried the fatty matters towards the surface while evaporating. The dry sewage-sick soil contained 9 per cent. of organic matter, and 19 per cent. of this consisted of fatty matter, and 9 per cent. of crude gum. The older idea that the inactivity of such soils is due, in the absence of clay, to the accumulation of

slime and fatty matter, is more probable than that the protozoa limit the activities of the bacteria.

Previous work by Dr. Greig-Smith had shown that the increased fertility of soils, occasioned by the employment of heat or volatile disinfectants, was caused by the heat destroying, more or less, the bacteriotoxins, and by the volatile disinfectants altering the disposition of the agrificere. But there remained the fact that phagocytic protozoa are in the soil, and that they may have some action, although not to the extent claimed by the Rothamsted investigators. Accordingly, the effect of directly adding protozoa to soil, was tested by noting their effect upon the growth of bacteria. The experimental work showed that the addition of a mixed protozoal fauna or of a pure *Amœba*-culture, did not lessen the numbers of bacteria. Instead of doing so, the bacteria always increased. The increase, which always was considerable, was traced to the freely-growing bacteria, which invariably accompanied the protozoa. The use of filtered soil-extracts, upon which Russell and Hutchinson based their idea concerning the activity of the soil-protozoa, did not bear out their contention, as there was so little difference between the action of filtered, as against unfiltered, extracts that it was concluded that the soil-protozoa have no action in limiting the number of bacteria in soils. This has since been supported by the work of Lipman in America.

Dr. J. M. Petrie, Linnean Macleay Fellow in Biochemistry, contributed two papers to last year's Proceedings—"The Chemistry of *Doryphora sassafras*," and "The Occurrence of Hydrocyanic Acid in Plants (other than Grasses), Part i."—which have appeared in Part ii. of the Proceedings. Part ii. of the latter paper is in preparation; and a systematic study of the occurrence of hydrocyanic acid in grasses, is in progress. About one hundred different grasses have been tested four times during one year, at intervals of three months; and the presence of hydrocyanic glucosides and their specific enzymes has been demonstrated in about twenty well-known species, but the occurrence is found to vary with the seasons. Other investigations are being carried out on the alkaloid Solandrine, on the alkaloids of *Duboisia myoporoides*, and *D.*

Leichhardtii F.v.M., from Queensland, on the occurrence of alkaloids in Australian species of the genus *Solanum*, and in the Native Tobacco and the Noogoora Burr, and on the poisonous properties of an introduced weed, *Stachys arvensis* Linn.

Mr. E. F. Hallmann, B.Sc., Linnean Macleay Fellow in Zoology, has been engaged, during the year, in a study of the Monaxonellid Sponges. A preliminary examination and classification of the available unnamed material have been carried out; and his first paper, embodying the results of his investigation of the Monaxonid Sponges described in Lendenfeld's Australian Museum Catalogue, will be ready for communication to the Society, in about three months' time.

Mr. A. B. Walkom has completed his investigations on the stratigraphical geology of the Permo-Carboniferous System in the Maitland-Branxton District, and also in the Glendonbrook District, near Singleton, and two papers, embodying his results, together with a third, giving notes on some recently discovered occurrences of the pseudomorph, Glendonite, will be communicated to the Society, at the meeting in April.

In answer to the Council's call for applications for three vacant Fellowships, issued last October, three applications for reappointment were received; but one of the applicants, Mr. A. B. Walkom, subsequently withdrew, in consequence of his appointment to the teaching staff of the Queensland University. I have now the pleasure of making the first public announcement of the re-election of Dr. J. M. Petrie, and of Mr. E. F. Hallmann to Linnean Macleay Fellowships, for another year, from 1st proximo; and in offering them the Society's best wishes for the successful development of the enterprises which they have in hand. I am glad of the opportunity, also, of offering Mr. Walkom the Society's hearty congratulations on his appointment to the Queensland University, coupled with best wishes for a prosperous and fruitful career.

I am glad of the opportunity likewise of offering the Society's congratulations to three other members—to Mr. J. E. Carne, F.G.S., on his safe return after a successful and adventurous geological expedition to New Guinea, and who, I may add, has

kindly promised to show us a series of lantern slides, illustrating his experiences, at an early Meeting; to Dr. H. I. Jensen, who left us, in September last, to take up the position of Geologist of the Northern Territory, which will now, for the first time, have the advantage of a resident geologist; and, lastly, to Dr. W. G. Woolnough, who has recently left us to occupy the Chair of Geology, in the newly-established University of West Australia, in which capacity, all those who know Professor Woolnough, have no doubt that he will amply justify his appointment.

The establishment, by the liberality of the Government, of three new Chairs, in Botany, Organic and Applied Chemistry, and Economics, in the University of Sydney; and also of seven Science Research Scholarships, are matters of the greatest interest and importance, and will materially strengthen the number of those engaged in research work in this State. Botany, especially, is a subject very much in need of the assistance which a Professorship and all that that implies, can give; for while systematic botany has not been neglected, the study of the morphology and embryology of our most interesting flora has languished for lack of teaching, of financial support, and of laboratory facilities. I have great pleasure in offering the Society's congratulations, good wishes, and a hearty welcome, especially to Dr. Robert Robinson, Professor of Organic and Applied Chemistry, and to Dr. A. A. Lawson, Professor of Botany.

I should also like to offer the Society's congratulations to two of our Members, Mr. G. I. Playfair, and Mr. R. J. Tillyard, on their appointment to Science Research Scholarships, and who will now be able to give their whole time to their work, instead of merely their "wearied leisure" as heretofore; while, at the same time, wishing that their emoluments more nearly approached those of the Macleay Fellows.

Only a few weeks ago our hearts were stirred by the sorrowful news of the tragic but heroic ending of Captain Scott's otherwise successful journey to the South Pole, with the details of which you are all familiar, from the newspaper reports, supplemented by Professor David's heartfelt commentaries thereon. As soon as pos-

sible, after the receipt of the news, I forwarded, on the Society's behalf, a cablegram expressive of sympathy, to the President of the Royal Geographical Society of London. To this brief statement, I shall only add, that the Lord Mayor's Fund is still open, and offers to us, individually, an opportunity of showing honour to the memory of Captain Scott and his gallant comrades, as well as practical sympathy with those who are left to mourn their grievous losses.

We are all thankful for the safe return of those members of the Mawson Expedition, who have come back recently in the "Aurora." But our warmest sympathy is due to Dr. Mawson, in his delayed return to his base under circumstances so exceedingly trying and depressing, necessitating another period of exile from home; nor can we forget his six companions.

A CENTURY OF CIVILISATION FROM A ZOOLOGIST'S POINT OF VIEW.

Though Governor Phillip occupied New South Wales in 1788, the advent of civilised man cannot be said to have made any impression upon the Australian continent outside the circumscribed area round Port Jackson until 1812 (just about one hundred years ago), when the increasing flocks and herds were able to pass over the Blue Mountains, and spread out, north, south, and west. The advance of the pioneer stockowners once started, soon brought about very marked changes in these, until then, virgin lands, even though it was simply a pastoral occupation of them until many years later.

In 1824, the site of Brisbane was selected, and a northern settlement came into existence; while, at this date, Sir Gordon Bremer formed military stations on Melville Island, and at Raffles Bay, on the north coast. Though these northern settlements were abandoned seven years later, they left their mark on the Australian fauna through the introduction of the Indian buffalo, which, spreading into the swamps and marshes beyond, increased into large herds.

On the 1st of June, 1829, Captain Freemantle hoisted the British flag on the West Australian coast, and, between that

date and 1832, a number of small but interesting expeditions were undertaken at the instance of Sir James Stirling, which greatly extended the knowledge of the western region.

About the same time, Victoria was invaded from the south by restless pioneers from the settlements in Tasmania, and from the north, across the Murray, by explorers and overlanders with their stock to occupy the rich lands of Australia Felix.

Soon after New Year, 1830, Captain Charles Sturt, who had left Sydney the previous year, started his adventurous voyage down the Murray, and reached South Australia, where, six years later, the town of Adelaide was laid out by Colonel Light.

With the settlement of Port Essington, on the north coast, when the military stations at Melville Island and Raffles Bay were abandoned in 1831, we may say that Australia was invested on all sides.

A remarkable idea, that had an important influence on the colonisation of Australia, was the general opinion of the settlers and explorers that the greater part of the central lands of the continent was marsh or desert, and much of the coast land useless for settlement. Captain Dampier, and the Dutch navigators, fresh from the rich tropical jungles of the East Indies, could see no future for the mud flats, and pindan scrub, which last hid the rich open forest-land of the north-west coast. It is also evident that it was the totally different aspect of the Australian bush-land, wind-swept plains, and stunted forests, with the parched soil clothed with tufts of brown bleached grass under a summer sun, which, compared with the green fields of England, damped the spirits of our pioneers.

The first inland explorers, working out westward in New South Wales, were very unfortunate in their seasons. First, they became entangled in the Macquarie Marshes; then they struck the River Darling in a time of drought, when the river

had dwindled down to a stream of salt water; and, years afterwards, Sturt's account of his enforced residence at Mount Poole for nearly a year, stamped these western lands of New South Wales as absolute desert. North of Adelaide, there is a large area of salt pans and marshes, which seemed to be always in the path of explorers from the south, and most discouraging accounts were sent in regarding the desolation of the north lands.

Nothing could be more depressing than to travel through the mallee country of Victoria and New South Wales in mid-summer; and even as recently as 1862, Tenison-Woods, in his "Geological Observations in South Australia," was only voicing the general opinion, when he said the Mallee Lands were worthless for settlement. Nevertheless, within less than twenty-five years, large areas are producing rich crops of wheat and fruit. In Victoria, in particular, they have been greatly developed under the Mallee Pastoral Leases Act of 1883. It is estimated that the area of Mallee Land in Victoria is about 12,000,000 acres; and that from 20 to 25 per cent. of this consists of open plains, and country timbered with pine, belar, bull-oak, and other scrub-trees. About 1,150,000 acres are under cultivation; and, in a second report, it was stated that, in spite of the dry season, the wheat-crops were much better in the Mallee than on the clay soils.

Twenty-five years ago, the wheat-farmers declared that cultivation could not be carried out on the red soil lands of the central area of New South Wales, and that ruin stared anyone in the face, who attempted cropping in the west; yet every year sees the wheat belt extending, and with improved methods of treatment and modern appliances, good returns are being obtained.

I would, in my address, try to point out some of the great changes that have been wrought by the advent of the white man with his domestic animals, in the displacement of the aboriginal population and the original fauna of this great continent, in a hundred years of civilisation.

The aboriginal population was estimated by Flanagan, in the whole of Australia, at 500,000. Krefft says that, in 1847, the natives in Victoria were estimated at 5,000 souls. Though these estimates were probably under the mark, and the native population was comparatively scanty, in proportion to the size of the country, they were uniformly scattered all over the land. A nation of hunters, they moved on with the game, and their numbers, in different localities, were regulated by the food-supply. Their hunting assistants were the dingos, which they were in the habit of catching as puppies, and training. In hard times, they often ate their dogs; and several explorers have recorded how the natives of the interior guarded their dogs, in fear that the intruders might want them for the same purpose. Even the wild dingos used to come and wander round the camps of the natives during the lean times.

After aboriginals and dingos, the most deadly enemy of the marsupial was the eaglehawk, which would even attack and kill a large kangaroo. Ernest Giles, speaking of Central Australia, says, "The greatest enemy besides the blackman and the dingo, is the large eaglehawk, which, though flying at an enormous height, is always on the watch; but it is only when the wallaby lets itself out on the stony open ridges, that the enemy can swoop down upon it. The eagle trusses it with its talons, smashes its head to quiet it, and finally, if a female, it flies away with the victim for food for its young."

No one, unless he has lived in unstocked country, has any idea how numerous the eagles and hawks are, before poison has been laid. I once counted forty dead eagles round a poisoned carcase, on an out-station in the north-west. Gould, in 1859, remarks on the number of hawks in Australia, and records 40 or 50 kites (*Milvus affinis*) on a tree, on the Manning River; while, thirty years ago, the whistling eagles used to congregate around every western homestead, like the turkey-buzzards on the cathedral roofs in South American towns

The natives were expert hunters, and where permanent water existed, had many ways of getting food, such as their fisheries on the Barwon River, where large numbers of fish were trapped by means of stone barriers. They caught ducks with nets, sometimes 20 feet deep and 100 feet in length, spanned across a river or creek, into which they scared the frightened birds by throwing up an imitation hawk. Krefft says,* "I have seen from 50 to 100 ducks taken in this manner at a single haul." Enormous quantities of eggs were also collected by the natives in their wanderings, so that the increase of the large birds was kept down in several ways. The periodic droughts were much more far-reaching than in modern days; immense areas became waterless, and though the natives often died, large quantities of game also perished.

The grass-eating animals were kept so well in hand under the systems adopted by the native hunters, and the carnivorous birds, that the grass was never eaten down as on stocked land; therefore, towards the summer months, it was often several feet in height, and was regularly fired by the natives, to enable them to get over the country, to catch their game, and also to harass their enemies with grass-fires, and attack them under cover of the smoke.

Stuart was much troubled, when crossing from Adelaide to the north coast, and was attacked several times under cover of the clouds of smoke. At Frews waterholes, he had a narrow escape. He says, "To-day they have set fire to the grass round about us, and the wind, being strong from the north-east, it travelled with great rapidity. In coming into the camp, three miles back, I and the two that were with me narrowly escaped being surrounded by it; it was as much as our horses could get past it, as it came rolling and roaring along in one immense sheet of flame and smoke, destroying everything before it."

* Trans. Phil. Soc. N. S. Wales, 1862-65.

I had a similar experience in North Queensland, on the rolling downs country, where the natives set fire to the spinifex ridges on the head of the Gilbert River, and sent twenty miles of flame through the long grass. Giles constantly refers to this habit: "To the north, west, and south-west the natives were hunting, and, as usual, burning the spinifex before them." Again, he says, speaking of the intense heat at Uder: "Nevertheless, the natives were about, burning, ever burning, one would think they were the fabled salamander race, and live on fire instead of water."

Before the advent of white men, the greater part of the surface of Australia was fire-swept towards the end of the summer, even the coastal parts being sometimes burnt out in large areas, as happened on the historic Black Thursday, when, in 1851, the greater part of Victoria and New South Wales was one great bushfire.

We can now consider the most striking changes that came with civilisation, and the passing of the aboriginals as a nation of hunters, the first of which was the enormous increase of the indigenous animals and large birds, not only caused by the disappearance of the native, but also by the partial extermination of the dingos and wild dogs, both of which lived upon the native fauna. The laying of poisoned baits by the squatters, for these pests, killed off large numbers of carnivorous birds, which also checked the undue increase of wild game.

This remarkable increase of marsupials, in particular, was very noticeable even in the early fifties. Wheelwright, in his "Bush Wanderings," when speaking of game, says that his party of kangaroo-shooters killed 2,000 in the season within thirty miles of Melbourne. And all over the forest-country, kangaroo-drives were the only way of keeping the larger marsupials within bounds. In both New South Wales and Queensland, Acts were passed, making it compulsory for the squatters to destroy kangaroos; an assessment *per capita* was made on all sheep and cattle, inspectors were appointed,

and a price fixed for scalps. In New South Wales, sixpence per scalp was paid all over the State, while, in Queensland, it varied from twopence to ninepence in different districts. This work was afterwards passed on to the Pastures Protection Boards, and Local Boards in each land district, with a General Council of Advice elected annually in Sydney.

Under the Pastures Protection Boards last year (1911), the following list of noxious animals destroyed, as proclaimed under the Act, was recorded, with the bonuses paid for them in New South Wales:—

<i>Names.</i>	<i>Numbers.</i>	<i>Bonus paid.</i>
Wallabies	505,129	£2,401 14 4
Kangaroo Rats	96,922	815 3 0
Pademelons	16,140	88 11 9
Wombats	255	7 6 0
Hares	163,064	1,205 19 3
Native dogs and pups	8,251	4,091 12 6
Foxes and cubs	26,278	3,561 11 3
Eaglehawks	5,328	428 7 0
Crows	89,133	2,311 16 0
Total	910,500	£15,511 12 1

In the Annual Report of the Department of Lands of Victoria, 1911-12, the cost of destroying vermin, under this Act, is given as £40,142 16s. 3d., including dogs and foxes.

During the last year (1912), a North Coast Crows and Flying Foxes Destruction Board was formed at Beinleigh, N.S.W., which includes ten shires.

The opossum, like the kangaroo, lost its enemies, and multiplied rapidly in all suitable localities. A writer in the *Journal of the Royal Society of New South Wales* (1885) considered that opossums were so numerous in several localities in Victoria, that, owing to the constant defoliation, large numbers of the forest gum-trees were actually dying. He pointed out that these forests, forty years before, had been the hunting ground of a tribe of 200 aboriginals, whose chief food-supply was opossums; and that, at the moderate estimate of 50 opossums a day, 200 natives would account for

18,000 a year. In New Zealand, where our opossums have been introduced and liberated only a few years ago, they have bred so quickly, free from all enemies, that they are now looked upon as a pest.

The emu, about which so much has been written as a vanishing bird, with a partial protection is more plentiful now in many inland districts, than it was when the natives caught the young birds in the long grass, hunted for the eggs, and would hide all day on the edge of a water-hole to kill them when drinking. Under the same conditions, we seldom saw a cassowary in the Cairns scrubs, in North Queensland, in 1880, when the blacks were numerous; but six years later, when I hunted over the same ground, they were quite common, because there were no blacks.

The next important change brought about in new country by stocking, was the hardening of the surface of the soil, the eating-off of the rough grass, and the consequent improvement of the pasturage. This is known to every stockman, and I had a striking example brought under my notice on the King's Sound Pastoral Company's station in North-West Australia, where, in the midst of about two million acres of unstocked land, there was a fenced-in paddock of about ten thousand acres, upon which the station sheep were depastured. Within three years, the enclosed land, though very lightly stocked, was transformed into a different and better class of country from that outside the ring-fence, which was poor and thinly grassed.

The original condition of the greater part of the sheep and cattle lands before stocking, was loose, friable soil, black loam, or sand ridges covered with scattered tufts of grass and herbage. This land, in the dry season, opened out in great cracks and fissures, or became loose, shifting sand, under the influence of summer sun and wind-storms. This was changed again, under the action of the fierce winter rains, into a quagmire, over which even the kangaroo found it difficult to travel. The carts and drays of the pioneers travelling over the road-

less plains and ridges, sank so far into the soil, that the deeply cut tracks often remained for years, useful guides to later travellers.

Dr. Woolls, in his "Plants of the Darling," says: "When, in 1865, Mr. E. Ford was surveying in that district, he wrote that it was quite impossible to find a moist spot on the Darling, everything being dry, parched and burnt up, whilst the ground was cracked in all directions with deep fissures."

The rapidity with which, even after heavy rains, the clay-pans, swamps, and marshes dried up in the interior, was startling to the traveller. Many of our large inland lakes and swamps, which have been permanent sheets of water for the last forty years, were, in the early days of settlement, only sheets of water through the winter and spring, and were quite dry long before the end of summer. This is evident from the fact, that there are many of these swamps and lakes, even at the present time, surrounded with a fringes of gaunt, dead skeletons of gum-trees, many of which must have been very old trees before the altered conditions came about, and they were killed by the accumulated water. The Kow Swamp, in the north of Victoria, is an example of this; from the present low-water mark at the end of summer, hundreds of dead, bleached red-gums encircle the clear water as far in as the low-water mark of olden times; while outward, to the high-water mark, the large red-gums grow with all their usual vigour. This swamp was perfectly dry in the great drought of 1865, but since the floods of 1870, it has been a permanent sheet of water, with an average depth of 2-3 feet at the end of the summer.

Not only did the stocking improve the pasturage, but the constant padding of the soil by the feet of the cattle, horses, and sheep, puddled the soil, so that the beds of the clay-pans, water-holes, creeks, and swamps, which previously had retained the surface-water for a very short time after rain, became so hardened and puddled, that the water became more or less permanent. The habit of sheep in following each other in strings, gives rise to

regular beaten tracks (sheep-pads), which, trending in all directions, usually lead down into the watercourses, forming regular gutters. There the accumulated water is still further retained in the clay-pans, because the fine clay and sediment, carried in the water, settles and forms a skin or coating on the bottom.

This is corroborated by Mr. W. E. Abbott,* who says, "The difference between stocked country and that which has never been stocked, is apparent even after a few years; the surface becomes firmer, and water runs where it never ran before." This makes a great difference in the quantity of surface-water that runs into rivers and swamps, and very soon rivers run with half the amount of rain that they did previously.

Stockowners were soon confronted with the important problem of the conservation of water for their stock during the summer months, and the further inland they moved out, the more serious the question of water became. The first method adopted was the formation of dams across the creeks, constructing embankments of earth when the creeks were low, and backing up the water, with a bywash on the side. These dams, however, were constantly breaking away with the sudden floods, so common in the interior, and necessitated constant watching and repairing.

The next step was the digging out of deep excavations with sloping sides, usually on the edge of some swamp or water-course, and the surrounding area cut with gutters leading into the excavation. These were known as tanks. Private owners soon found the value of this impounded water, and, in 1869, the Government of New South Wales saw their advantages, and started similar watering places at intervals along the main stock-routes; these were afterwards known as Government Tanks. The sum of £5,000 was voted for the construction of watering places between Booligal and Wilcannia under the supervision of the Roads Department, and these were found to be so valuable that similar excavations were carried out in other places; so that between 1882 and 1883, the sum of £103,000 was expended by the Government. These Government

* "Water-Supply in the Interior of New South Wales," Journ. Proc. Roy. Soc. N. S. Wales, xviii., 1884. p.85.

Tanks were fitted with pumps and watering troughs for travelling stock; and were sublet by the Lands Department to contractors, who took charge, and had a fixed scale of prices for supplying travellers with water.

Water was also sought for by sinking wells, but with few exceptions, in the dry country the supply of water obtained was scanty; and though sufficient for the homestead or passing traveller, made very little difference to the development of the surrounding country. The next great factor in Australian settlement was the discovery of artesian water under a very large area underlying some of the most waterless country in the interior. One of the first suggestions as to the possibility of finding artesian water in this country, was made in a work entitled "Journals of Several Expeditions made in Western Australia, 1829-32, under the sanction of Sir James Stirling," published in London in 1833. In the introduction, the author says: "Now our journalists assure us that they have always found water by digging, sometimes with their bare hands, only to the depth of one foot; if this be true, as there is every reason to suppose it is, the common mode of well-sinking would be tolerably certain of obtaining a supply, and the method of boring so successfully attempted in France and England, called the Artesian Well, might finally be called to the settler's aid with an entire dependence upon its efficacy."

The geologists always hoped to obtain artesian water, and, in 1851, experiments were carried out in putting down bores through the Hawkesbury Sandstone, but the results were nil.

In 1879, Mr. H. C. Russell, Government Astronomer, at a meeting of the Royal Society of New South Wales, stated that the rain-water which fell in the interior of Australia, did not flow down to the sea in the river-drainage, but sank into the soil, and accumulated underground. The actual demonstration of the existence of artesian beds was first recorded by Mr. C. Wilkinson* at Officer's Killarah Station, near the Darling River, where water was struck at a depth of from 134 to 142 feet, and shot up above the tube a distance of 26 feet. In 1901, according to Mr. Pittman, 158 bores

* Proceedings of the Linnean Soc. of New South Wales, vi., 1881, p.155.

were sending out artesian water at an estimated yield of over 77,000,000 gallons per day, the deepest bore being 4,086 feet, with a flow of 745,200 gallons a day.

Artesian water is now found beneath a very large area in Central Queensland; and, in similar country in New South Wales, it is estimated to extend under 83,000 square miles.

Quite recently another area containing artesian supplies, in a different geological formation, has been tapped in Western Australia, so that the artesian basin of the dry lands may extend over a very large area yet to be proved.

By the discovery of these great underground reservoirs, most wonderful changes have been wrought. In country where stock and stockmen struggled, and often perished for want of water, artesian supplies tapped, it may be, 3,000 feet below, shoot up above the top of the bore-pipes in a glittering fountain, spreading round into the neighbouring lagoon a bountiful supply for all.

In 1881, I saw 300 head of fat cattle stampede for want of water, between the Saxby and the Flinders Rivers, and these died along the back track, where now there are several fine bores. In the same district, between Taldora and Cambridge Downs, on the mail route to Normanton, we had a waterless track for 80 miles, during the midsummer months, which is now supplied with artesian water.

The alteration of forest-lands may next claim attention. With the exception of the fringe along the slopes of the eastern coast of Queensland and New South Wales, spreading out in Gippsland and Cape Otway in Victoria, and also the south-west corner of Western Australia, there is little of what we may call true forest in the 2,944,600 square miles comprising Australia. There are, however, large areas of scrub, and open, stunted forest-land, where grass and herbage struggle for existence. Under the various Land Acts which came into force in the different States, certain conditions were generally made, allowing the leaseholders certain vested rights, when they expended money in making permanent improvements. Among these, one form of improvement largely availed of, by the squatters, was known as ringbarking.

Ringbarking is a simple method adopted in this class of country for killing off the timber without the expense of cutting down or digging up the trees. It consists of cutting a scarf through the bark, right round the trunk, with a second one a few inches below, and then tearing off the detached ring of bark between; later on, experience showed that one scarf was just as effective. This caused the gradual death of the trees thus treated; and a greatly increased growth of grass and herbage ensued in consequence. According to Mr. Abbott,* this method was first adopted on the watershed of the Hunter River in 1860; ten years later, it was general in other districts; in 1880, fully three-fourths of all the purchased, and much of the leasehold land on the Hunter had been ringbarked. The landholders soon noticed the wonderful improvement in the quantity and quality of the grass on ringbarked land in comparison with the stock-carrying capabilities of the natural scrub-land; and this rapid and cheap method of improving the pasturage was universal over this class of country in Australia. When first adopted in 1860, many of the squatters declared that the destruction of the forest-trees and scrub would tend to the drying up of all the intersecting creeks and watercourses. After careful observations, extending over ten years, Abbott stated, in the paper previously quoted, that, in the Hunter River district, ringbarking had produced the opposite effect, for while, between 1850-1860, the creeks were seldom running, and were usually quite dry in the summer months, he found, after the death of the timber, that these watercourses became permanent creeks with a constant flow of water. This, he considered, might be due to two causes; first, that the dead roots acted like drain-pipes through the soil into the creeks, or, secondly, that the live roots of the trees had sucked up the greater part of the rainfall prior to the ringbarking.

Time has since shown that, in many places, ringbarking added much more to the fertility of the soil, than grubbing out and burning off the green timber. The slow decay of the roots beneath, and the rotting of the falling leaves, bark, and branches, returned more

* "Ringbarking and its Effects," Journ. Proc. Roy. Soc. N. S. Wales, xiv., 1880, p.97.

to the soil than the ash from the burning of heaps of dry timber. This is frequently demonstrated, in a smaller way, in orchard-lands, results showing that fruit-trees planted in "green land"—that is, directly the living forest has been cleared off—do not thrive as well as those set out in land in which the trees and scrub had been killed and retained, before being taken up for an orchard.

On some of the ringbarked western lands, the owners now find it is often advisable to leave all the smaller bits of wood and bark from the dead trees, upon the surface of the ground, when clearing up; for they act as a mulch, and keep the surface-soil from being cut up and blown away by the action of the summer sun and winds.

The stocking of the country in the western lands and the consequent suppression of bush-fires on the plains and in open country, from the absence of grass, brought about other conditions. One of the most conspicuous of these, was the appearance of millions of small pine-trees, which overran thousands of acres of land on the back-blocks of the Lachlan and other parts of Western New South Wales, land which had previously been open and lightly timbered, or well grassed plains.

This became so noticeable about 1880, that many theories were advanced to explain the cause of this wonderful growth of pine-seedlings. The most general idea was that the wholesale ring-barking, which had been instituted by the squatters for some years, not so much to improve the scrub-lands, as to secure the leaseholds against the free selectors, had brought about this new evil.

There were, however, probably several causes, all working together. First, the stocking of the land with sheep to its fullest capacity, as was the custom about this time, left no dry summer grass, and there were consequently no bush-fires. Next, ring-barking the existing timber opened the soil to light and air, but, in consequence of the value of the timber for fencing and house-building, all the large, mature, cypress pine-trees were left untouched; therefore, the pine seeds dropped on to resting soil, and were scattered far and wide by the wind. Thousands of sheep passing through the dead scrub, and finding shade under the big pine-trees, helped to bury the seeds in the loose soil.

Within a few years, very large tracts of good open grazing land had changed into impenetrable scrub, through which it was hardly possible to ride. The appearance of this "pine-scrub" was one of the reasons that led the New South Wales Government to pass an Act to restrict ringbarking or the cutting of timber under a certain size, without special permission from the authorities. There have been many instances, in other parts of Australia, of the gradual encroachment of trees and scrub upon open grass-land, when the conditions that restricted their advance have been removed.

On the other hand, we have records, by some of our earlier explorers, of dense undergrowth and scrub, in places which now we find only open forest; as on some of the old roads over the slopes of the Blue Mountains. There are many causes, besides bush-fires, that bring about these changes. Wattle and gum-scrub are often destroyed by wood-boring insects. I do not think that the bush-fires have altered the face of our coastal forest-lands, for the recovery and rapid growth of trees after these fires, is characteristic of this country. The development of the rich sugar-lands of the Queensland coast, and the dairying industry in the northern districts of New South Wales, have been responsible for the destruction of most of our eastern forests; but this has been inevitable, for the land was too rich and productive to remain virgin forest. It is only history repeating itself, for the whole of Southern Europe, from Turkey to Southern France, was, in the dawn of history, covered with huge forests, of which, now, not a vestige remains.

There are large areas of rugged broken land in all the States, that are of little value for settlement; and these should be reserved for forest-conservation, and scientific re-forestation. The forest-reserves in the sand-hill, and box and cypress country, should not be thrown open for selection; at the most, many of them would only support three or four families, if cleared and burnt-off; whereas under a proper supervision, they will produce timber-trees and firewood for centuries, for the surrounding settlers.

Many noxious plants and weeds have been accidentally introduced; some, after a brief course of luxuriance, die out, while

others like the briars, Lantana, and prickly-pear, have made good their footing; but this aspect of the question cannot be dealt with here. Increasing land-values and closer settlement will be the chief factors in reclaiming such lands.

The transformation of Australia has been effected by the introduction of the domestic animals of Europe, and the vanguard nearly always consisted of cattle. It was cattle that first went down the passes of the Blue Mountains to the Bathurst plains; and they spread rapidly. Mitchell found many cattle running on the Lachlan, when going south-west on his expedition in 1835; and on his return from crossing Victoria, in the following year, he met many mobs with the overlanders going south, from New South Wales cattle-stations.

Cattle and horses trample down the soil, eat off the rough grass, and improve the land for later occupation by sheep. In many instances, particularly in North Queensland, in the "sixties," sheep men made very heavy losses through disregarding this rule, and hundreds of sheep were killed through the seeds of the spear-grass.

There was no indigenous animal in Australia allied to horned cattle, and all the early importations came direct from England, except a few obtained at the Cape on the way out, so that all our original stock were free from stock-diseases prevalent in other parts of the world; and they thrive and increased accordingly.

There were some outbreaks of pleuro, chiefly in the coastal districts; but there was no epidemic until the outbreak of Cattle-tick Fever or Redwater, in the Northern Territory, in 1885. This virulent disease, which frequently destroyed 50 per cent. of the herds, first made its appearance among the working bullocks and travelling stock on the Roper River; while its immediate spread into Queensland was due to the establishment of boiling-down works on the Norman and Albert Rivers, and the consequent influx of tick-infested cattle.

A similar outbreak had occurred in the south-western portion of the United States, in 1868, and the results of the scientific investigations carried out in America, gave our stockowners some data to start upon, and the disease, in Australia, was proved to be iden-

tical with, and caused by the same kind of tick. In 1896, a Tick Conference was held by the Queensland and New South Wales Governments, when it was shown that the whole of the northern half of Queensland, taking a line from Longreach to Townsville, was tick-infested; and only a few years later, the cattle-tick reached the northern boundary of New South Wales. The cattle-tick also travelled westward, and soon infested most of the cattle-stations on the north-west of Western Australia.

Until recently, Redwater, or Tick-fever, was supposed to have been introduced from India or Timor with the buffalos; but later investigations show that the buffalos are immune, and that the disease was introduced from the Dutch East Indies with cattle from that region. The buffalos have made their mark in the north, though seldom ranging far beyond the swamps and marsh-land; but some idea of their increase and number is indicated by the fact that 100,000 buffalo hides have been exported from the Northern Territory during the last thirty years.

In spite of periodic droughts since the industry of cattle-breeding has been carried on in Australia, and the frequent losses in consequence, and in spite of the devastating Tick-fever, the growth of our herds has steadily increased. From the last returns available, there are 11,744,714 cattle in Australia and Tasmania, of which 5,131,699 are in Queensland.

The horse has followed the cattle, and without his aid much of Australia would have remained unexplored for many years. The horse thrives in all parts of Australia, under domestication, and in many of the more rugged or timbered districts, horses escape from the paddocks, and running wild, have increased until they became a regular pest on the runs. They were popularly known as "Brumbies," and in many places were hunted and shot for the sake of their hides. On a large station in Riverina, in the early "seventies," over 2,000 wild horses were thus destroyed at a cost of three shillings per head. At the present time, the number of horses in Australia and Tasmania is set down at 2,146,049.

The first sheep landed in Australia came from the Cape of Good Hope with Captain Phillip's fleet, in 1788, and were 19 in number.

In 1795, Macarthur had raised his flock to 1,000. In 1810 only 167 lbs. of wool were among our exports; but the introduction of the merino increased both the quantity and value of the fleece, and, in 1843, the wool industry was well established.

Though some of the coastal country was found unhealthy and fluke-infested, the open forest and ranges, with the great western plains, were found to be ideal country for the development of sheep; and, in about 1841, the supply had increased beyond the demand, and good sheep were selling for eighteen pence a head. Catarrh appeared in many of the flocks, and 70,000 died, in one season. This was followed by the accidental introduction of the Sheep Scab, which spread with alarming rapidity, so that at the time of the opening out of the gold-diggings, all the southern flocks were infected. In New South Wales, between 1848 and 1855, many squatters were ruined, and it was worse again from 1863 to 1867, on account of the arrival of large mobs from Victoria. Active measures thus came into force, and the Government, by constant supervision and regular dipping, finally stamped it out, and the State was proclaimed clean in 1868. South Australia was infected in about 1850-1 by imported sheep from Tasmania or Victoria, but similar legislation stamped it out in 1866-67. Scab never entered Queensland, but was common in West Australian flocks down to 1890. It is said to have come direct from England about 1830, with a small consignment of sheep imported by a company of settlers.

Though immense losses have taken place during the great droughts, and millions of sheep have died, the number of sheep in Australia has regularly increased; so that, at the present time, there are over 92,000,000 sheep in Australia and Tasmania, and the wool-clip in 1910 was worth £14,727,000.

The last of the larger domestic animals introduced into Australia, was the camel. The generally accepted idea that the greater part of inland Australia was a desert, suggested that "the ship of the desert" should be used for transport. As far back as 1837-43, Captain Stokes, in his "Discoveries in Australia," advised that camels should be introduced from India; and he suggested that they could be landed on the north-west coast of Australia at a very

reasonable cost. It was not until 1860, however, that the first camels, twenty-four in number, with their native drivers, were imported from Peshawur, India, by the Committee of the Burke and Wills Exploring Expedition. Of these, Burke took sixteen with him in his reckless dash across to the north, of which only one reached Cooper's Creek on the return march. Camels were not used in the construction of the Transcontinental Telegraph Line (1870-2), but Colonel Warburton took seventeen in his expedition across Western Australia in 1873, only two of which reached the Oakover River. About the same date, Messrs. Smith and Elder imported camels for use on their inland stations from Adelaide, and fitted Ernest Giles out with seventeen camels for his second expedition across Western Australia. From this date, camels have been used in considerable numbers for carrying stores and wool, in the northern and western lands of Australia. They were first used in Western Australia by Mills, who brought thirty from South Australia to Northampton to carry on the construction of the telegraph line thence to Carnarvon; and later, in 1886, Mr. McNulty (the present Under-Secretary of Agriculture, W.A.), brought, so he informs me, ten camels to explore the country round Nullarbar Plains and Queen Victoria Springs.

When the Kimberley Goldfields were discovered, camels were imported in large numbers; and, in 1887, one lot of three hundred were landed on the north-west coast, and many of them sold at very low rates. They are, at present, used in considerable numbers in the interior, and the latest statistics give their numbers as 3,000 in South Australia, 1,200 in New South Wales, and in Western Australia.

Though the introduction of the camel has not done much in altering the natural conditions of the country, it has had a good deal to do with opening up the dry lands of Central Australia, and has thus added to the development of the States.

The introduction of the rabbit (*Lepus cuniculus*) has done more to alter the natural conditions of animal and plant-life in Australia, than the vast herds of cattle and mobs of sheep. The wild rabbit, originally a native of Spain, was introduced into England

at a very early date. An Act was passed, in 1605, by Queen Elizabeth, dealing with the unlawful hunting of deer and conies. In the reign of George III., persons stealing rabbits from unenclosed warrens, could be transported for seven years, "or suffer such other lesser punishment by whipping, fine or imprisonment as the Court shall at their discretion award and direct."

We have no accurate account of when the first rabbits reached this country, but the first record of their existence in Australia is to be found in Captain Stokes' "Discoveries in Australia" (Vol. ii., p. 426). Speaking of Corner Inlet, Victoria, he says: "During the examination of this great useless sheet of water, the ship lay near a small islet, close to the promontory, about seven miles from the entrance, which, from the abundance of rabbits, we called Rabbit Island. I have since learnt that these animals multiplied from a single pair, turned loose by a praiseworthy sealer, six years before, and encourages me to expect a similar result from the gift I had bestowed on Kent Group." Thus, though not on the mainland, they were plentiful quite close to Wilson's Promontory seventy years ago. Mr. J. H. Kershaw, who first called my attention to this record, informs me that the descendants of these rabbits are still plentiful, but, through inbreeding, have all become much smaller than those on the mainland, and are almost black in colour.

There were, doubtless, many attempts made to acclimatise the rabbit in Australia. In 1858, a colony was established on the Upper Murray, which, after flourishing for three years, died out. It appears that, in 1860, the rabbit, as a wild free animal, was unknown in Victoria, for, in a Prize Essay on Agriculture, printed at that date, the author (Mr. Storey) advocated the introduction of the wild English variety.

It has been generally asserted that the progenitors of the present plague rabbits were liberated between Geelong and Colac, by a well-known landholder, for sport, sometime between 1864 and 1870; but the exact date will always be a matter of doubt, for no one is anxious to claim the distinction. The President of the Acclimatisation Society of Victoria, at the Annual Meeting in 1890, while noting the spread of the rabbit, "desired to state that

the Society was not responsible for the introduction of this terrible rodent-pest."

In South Australia, Mr. Samuel White, between 1854 and 1855, turned out rabbits on his land at Wirrabeen, where they remained without any rapid increase in numbers until about 1868, when they began to spread out, and, by 1870, covered a large area. In 1876, they were recognised in South Australia as a pest, and the Government passed a Bill for their destruction. Under this Act, destruction-camps were formed, and large sums of money expended in trying to exterminate them.

Legislative action was first adopted in Victoria in 1880, when power was granted to the Municipal Authorities to destroy rabbits; but this not meeting the requirements, the Act was repealed, and the Government passed the Vermin Destruction Act.

It is somewhat remarkable that, just about the same year, the rabbits from the Stony Rises, about Colac and Geelong, in Victoria, and also the rabbits in South Australia, began to move on northward. I knew the Murray country, from Euehuca to Swan Hill, Victoria, in 1875, before the vanguard of the advancing army of rabbits had reached our country; but, in 1879, they were swarming through all the sand-hills, flats, and mallee-scrub. In 1879, they were killed near Balranald, though these may have been stragglers from the South Australian invasion. In 1880, the rabbits crossed over at Murray Downs Station into New South Wales, and spread rapidly over the south-west.

The seriousness of the pest was so apparent, that the New South Wales Government passed the "Rabbit, Nuisance Act," in May, 1883. Under this Act, inspectors were appointed, and, later on, a Rabbit Branch was created in the Department of Mines. Under the regulations of the Board, the owners of infested lands were compelled to engage gangs of men to destroy rabbits; and, between the date of the passing of the Bill and the end of 1886, the Government paid out £361,492 in the purchase of rabbit-scalps, and incidental expenses, and recorded the collection of 7,852,787 scalps. At the same time, many landholders had expended large

sums to stem the advance of the rabbit, with very little success; for, at this date, not a single Station from the South Australian border, in the west, to the 146th parallel, or forming a line from Brewarrina on the north and Gundagai on the south, was free from rabbits.

After crossing the Murray, the rabbits travelled steadily northward, spreading east and west as they advanced, at the rate of sixty miles per year; and crossed the Queensland border, at a dozen different places, in 1887. Here they met the western rabbits, which had moved on from South Australia towards the Warrego River, and joined forces in Queensland.

In 1888, the New South Wales Government appointed a Rabbit Commission, the members of which met in Sydney, and considered the various projects brought forward to exterminate rabbits by introducing contagious diseases. Dr. Watson, of Adelaide, suggested the importation of Rabbit Scab from Germany. Drs. Ellis and Butcher carried out a number of experiments to destroy the rabbits with an indigenous disease at Tentonology, near Wilcannia; and Pasteur offered the microbe of chicken-cholera from Paris. At the conclusion of this conference, the Government offered £25,000 for an approved satisfactory specific to destroy the rabbits. In 1890, the New South Wales Government passed a New Rabbit Act, superseding the Rabbit Nuisance Act of 1883, under which it was estimated that £1,543,000 had been expended in fighting rabbits. This money was first obtained through a direct tax upon all landholders, but the sum collected was so inadequate, that it had to be supplemented by £503,786 from the consolidated revenue. The natural enemies of the rabbit were studied, at home and abroad; wild cats did a little; monitor lizards are specially protected under the Stock Act, on account of their known habit of eating rabbit, but, though they do eat young rabbits, they are deadly enemies to the opossum and other harmless creatures, and are carrion feeders.

Someone imported 120 mongooses, but they, fortunately, died out, and the experiment was not repeated. The fox has even been regarded as a friend, by some of the large landholders, because, while rabbits are plentiful, he leaves the young lambs alone.

All sorts of mechanical methods have been tried—digging out, suffocating by forcing bisulphide of carbon fumes into the burrows, trapping, the burning up of all logs and stumps, and finally wire-netting fences. Under the regulations of the present Act, poisoning has been enforced on all rabbit-infested land, the local Boards having power to summons and fine neglectful landowners.

The erection of wire-netting fences has been encouraged. Queensland, New South Wales, and West Australia have spent large sums in erecting barrier-fences, some hundreds of miles in length, to check the spread of the rabbits. In New South Wales, the State rabbit-proof fences total 1,322 miles, erected at a cost of £69,885; private owners have put up 81,235 miles of wire-fencing, at a cost of £4,611,427; while the Pastures Boards own another 348 miles, which cost £14,459.

The Under-Secretary of the Department of Public Lands, in Queensland, informs me that the range of the rabbit in that State is as follows:—"The Warrego district, the western part of the Maranoa, with the Carnorvan, Gregory North, and Mitchell districts more lightly infested." The estimated length of all the rabbit-proof fences, at the end of 1911, was 19,303 miles, including the Government Border fences of 732 miles; and the expenditure by the Department for that year, in dealing with the rabbits, was £24,699. The total cost of operations since the Boards came into force is, Government expenditure £842,478, and by the District Boards and Run-owners, £893,977, or a total of £1,736,455. This, however, does not include the outlay of the runholders on the destruction of rabbits, which runs into a very large amount of money.

The rabbits entered the eastern boundary of Western Australia from South Australia, and the vanguard of the army reached Eucla in 1898. They are now spread over a large area, from the South Australian border to the Barrier Fence, about 180 miles from the coast, that runs from the Great Australian Bight, and strikes the Indian Ocean about 100 miles north of Condon. Between the Barrier Fence, and what is known as the No. 2 Fence,

about eighty miles further west, there are a number of rabbits in places.

In 1896, the pastoralists of New South Wales collected a sum of money for the purpose of bringing out a specialist from the Pasteur Institute of Paris, to experiment on the practicability of inoculating the rabbits with some virulent organism that would spread and destroy them. Dr. Danysz came out, and, under the supervision of the Board of Health, carried out his investigations at Broughton Island; nothing practical, however, eventuated.

Though when years of drought come round, the rabbit plague decreases; yet, as soon as good seasons take their place, the rabbits, if neglected, are as abundant as ever, in spite of the enormous sums expended in trapping, hunting and poisoning, in experiments carried out to infect them with contagious diseases, and in the miles of wire-netting encircling the pastoralists' holdings.

The only thing that will control the rabbit, is closer settlement, subdivision of paddocks, and wire-netting. Of course, some new factor may spring up, and the balance of nature be restored. There has been a marked difference in the native flora since the introduction of rabbits, for they have not only eaten out the grass by the roots in many places, but all kinds of herbage, plants, shrubs, and seedlings have been eaten down or barked, even to the smaller scrub-gums, until the land has become "rabbit-sick"; and even with good seasons, it will be years before many of these plants will reappear.

In several of the methods used in fighting the rabbits, the native animals and birds have suffered as severely as the plants. The universal distribution of phosphorus and pollard by means of the poison-cart, claimed to be one of the most effective methods of destroying rabbits, has killed off an enormous number of the most useful insectivorous birds, so that the magpie, laughing jackass, stone plover, and other birds have almost disappeared where the poison-cart is regularly employed. In some of the western land, where poisoned water is used, often in a very careless manner, all conspicuous living things die out with the rabbit.

Besides the destruction of the flora and fauna, there is another very important aspect of the rabbit-question, that cannot be overlooked. The effect that the constant killing of rabbits, often in a very brutal manner, has upon the minds of the people engaged in rabbit-trapping, is to be deplored. The callous way in which boys and girls treat maimed rabbits, has been frequently noted. The School Inspector of the Yass district recently reported that 20 per cent. of the children in the smaller schools were engaged in trapping. When rabbiting is seriously undertaken, it occupies a great part of the time of the children when out of school, and seriously encroaches on their hours of sleep, as they work at the traps till late at night. Opinions differ among the teachers as to its effect, but there is a general consensus of opinion that it induces not only physical, but also mental and moral deterioration. In the Mudgee district, over two hundred children are engaged in rabbiting, from four to six months in the year.

On the other hand, it is claimed that the rabbit has created an important industry, employing a great many people at good wages, collecting and distributing a valuable food-supply. The pecuniary value of the rabbit-industry is certainly important. Frozen rabbits and hares exported from New South Wales last year (1912) were valued at £252,053, and exported skins at £318,930, while the estimated value of by-products totalled another £57,000. The total for the Commonwealth, for frozen rabbits and skins, reached £1,053,331.

In spite of this large sum returned from rabbit-trapping, it is not a true source of wealth, but a parasitic growth upon our most important wealth, the sheep and wool; and Australia would be much richer without it. The rabbit has, and still is, destroying annually millions of pounds' worth of our best assets. On one station alone, in a single season, a bonus of sixpence per scalp was paid on 500,000 rabbits, in one season. In New Zealand, in 1886, it was estimated that the rabbits were eating the grass of from five to six millions sheep, and costing, per annum, at least £1,500,000.

The hare (*Lepus europaeus*) is so closely related to the rabbit, that it is hardly necessary to deal with it in detail. It was intro-

duced into Australia in the same manner as the rabbit; but, though thoroughly established over the greater part of the settled districts of the southern and eastern States, with a few exceptions, it has done no very serious damage. Its chief depredations have been in orchards, where it delights to gnaw the bark of fruit-trees, and in cultivation-paddocks. It is somewhat remarkable that, when the rabbits come into a district, the hares move out.

The fox (*Canis vulpes*) was introduced into Australia, it is said, about 1868, by some of the members of a Hunt Club, for the purpose of indulging in the noble sport of fox-hunting. They were turned out in Southern Victoria, about the district of Geelong or Colac; but as no one, now, wishes to claim the honour of the introduction of the fox into Australia, it is very difficult to get any accurate records on the subject. Like the rabbit, it was some years before the fox became acclimatised, and established itself under the new conditions of life; for it was nearly twenty years later, that foxes were first noticed on the southern border of New South Wales. At first, they made their way northward through Gippsland, keeping to the forest and scrub-lands of the eastern coast; but within the last ten years, they have spread all through Riverina out into the scrub-lands of the western plains, and are now generally distributed all over the State. It is evidently only a matter of time, when the fox will be found all over Australia. Last year, the Armidale Pastures Protection Board paid for the scalps of 367 adult and 117 cub foxes, while the combined bonus of all the Protection Boards in New South Wales amounted to £3,561 for the scalps of 26,278 foxes.

A very large portion of Australia is admirably adapted for the home of the fox, and it is very easy for them to make their "earths," or to enlarge rabbit-burrows in the scrub and sandhills, where the natural food of the fox (the rabbit) is plentiful. That the fox has not become such a serious pest to the sheep-breeders as was at first expected, is due to the abundance of rabbits; what they will do when the rabbits are reduced down to normal, it is hard to say; and though, in England, they are almost omnivorous, feeding upon rats, beetles, and even snails and worms in hard

times, here, in the great open spaces, lambs in paddocks will be much more palatable food.

Though many of the squatters have rather tolerated the fox, or, at least, have not taken active measures against it, on account of its rabbit-hunting habits, it has not been the case with the farmers who breed poultry. In fact, the advent of the fox into the southern districts, has been a very serious blow to poultry- and turkey-breeding in particular. All poultry had to be shut up at night in wired-in yards; and, in many places, this profitable branch of farming has been abandoned, simply on account of the trouble with foxes.

Another change that the fox is bringing about is the destruction of the larger ground-nesting birds, such as the lyre-bird and scrub-turkey, in the coastal brushes; and, in the west, the mallee hen, pigeons, and wild ducks will all share the same fate.

Of course, there is very often an unseen enemy that appears and evens up things, and with the foxes frequenting the coastal scrubs north of Sydney, this appears to have come in the shape of the common bush- or dog-tick. An observant friend informs me that, this last year, on his land at Narrabeen, he has found several dead foxes in the scrub, showing signs of tick-infestation.

In this necessarily brief summary, I have tried to show some of the new conditions that have come about during a century of civilisation; and that, in spite of mistakes due to the want of knowledge of the life of this new land, we have steadily gone ahead, as an agricultural and pastoral community. Australia is a land capable of growing rich crops of cereals, lucerne, and other fodder-plants, under scientific cultivation. The latent fertility of our driest lands has been shown, where water can be applied; with a close study of the climatic conditions, the composition of the soil, and the selection of the most suitable hardy varieties of wheat and other cereals, our farmers are reaping the reward of their intelligence and industry. We are rapidly developing a nation of farmers, who will be able to hold their own in the markets of the world. The improvement in the character of our live stock has been also going on; our stockowners have imported the very best



stud-cattle obtainable, while the Government has helped the smaller herds of the dairy farmers with their stud-cattle farms.

Above all, Australia is a land capable of carrying great flocks of sheep, with a climate exactly suited to the fine-woolled sheep of the merino type; and our stock-owners comprise a large number of men who have spared no expense, or attention, in the production of the finest fleeces, both in quality and quantity, our wool is improving every year, and is competed for by the manufacturers of the world.

The old antagonism between the woolgrowers and the wheat-growers dates from the time when the free selectors cut up the sheep runs; but now we see the squatters finding that they can grow wheat profitably, and the farmer has his sheep in conjunction with his crops.

The sheep will not decrease in Australia, as some writers suggest, but will increase as rapidly under the new conditions as the wheat, though they will be divided up into smaller flocks. In Great Britain, so small in area, compared with Australia, there were in 1911, 26,494,992 sheep, most of which are made up of flocks of a few hundred in number.

The civilisation of the empty spaces of the interior will go on as it has in the past nearer the coast, slowly but surely, until the flocks and herds meet from the east and west.

Mr. J. H. Campbell, Hon. Treasurer, presented the balance sheet for the year 1912, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that it be received and adopted, which was carried unanimously.

Abstract: GENERAL ACCOUNT, Balance from 1911, £139 3s. 1d.; income, £1,044 5s. 0d.; expenditure, £956 18s. 9d.; transfer to Bookbinding account, £18 18s. 0d.; balance to 1913, £207 11s. 4d.

BACTERIOLOGY ACCOUNT, Balance from 1911, £71 1s. 3d.; income, £483 10s. 3d.; expenditure, £489 5s. 9d.; transfer to Capital account, £26; balance to 1913, £39 5s. 9d.

LINNEAN MACLEAY FELLOWSHIPS ACCOUNT, Income, £1,562 4s. 5d.; expenditure, £1,001 15s. 0d.; transfer to Capital account, £560 9s. 5d.